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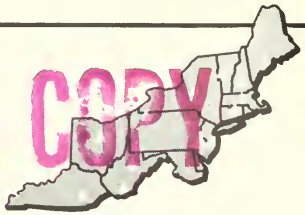

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TUBING vs. BUCKETS: A COST COMPARISON

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Abstract.—Equipment investment for tubing-vacuum systems was significantly less than that for bucket systems. Tubing-vacuum systems required about 22 percent less labor input, the major labor input being completed before sap-flow periods. Annual cost of operation was less for tubing-vacuum than the bucket system. Small tubing-vacuum operations showed more profit potential than small bucket operations. Also, tubing-vacuum operations showed a 28 percent increase in sap volume yield as compared to bucket systems.

Which method of maple sap production costs less—buckets or plastic tubing with vacuum pumping? Our studies show that plastic tubing with vacuum pumping costs less.

For two sap seasons (1972 and 73) we studied the total costs involved in maple sap production in operations of various sizes, for both the bucket system and the tubing system with vacuum pumping. We also compared the two collection systems on a cost-per-tap basis to determine if one system has a cost advantage over the other.

Data Collection

Cost records for sap production were kept on 15 maple syrup operations in Vermont during the 1972 and 73 sap seasons. Of these, 7 were plastic-tubing operations, using either wet or dry vacuum; and 8 were traditional bucket operations. For both collection systems, the size of the operations ranged from approximately 600 taps to 4,200 taps.

Field data were collected in two phases. In phase I, a complete inventory of all equipment used in sap production was made on each sugarbush. In addition, any materials used—paint, fuel, oil, wire, etc.—were recorded and included in the cost.

Phase II of the study consisted of a time study of the labor inputs required. Labor input was classed by specific work activity:

1. *Preparation time.*—Cleaning and repairing equipment, storage tank preparation, etc.

2. *Set-up time.*—Installation of mainlines and small tubing lines, tapping, setting spouts, scattering and hanging buckets, etc.
3. *Sap-gathering time.*—Inspecting buckets, gathering sap, dumping ice or spoiled sap, etc.
4. *Checking time.*—Checking the tubing system for leaks and making necessary repairs.
5. *Take-down time.*—Disassembling the system.
6. *Clean-up and storage time.*—Cleaning and storing all equipment.

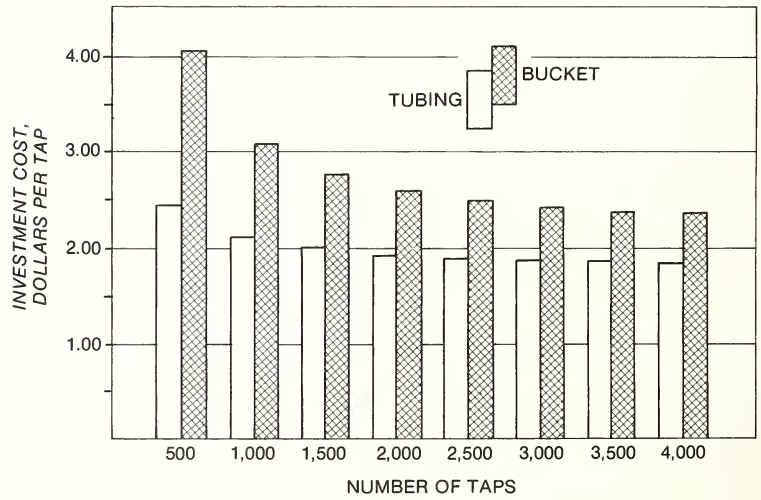
All times were recorded to the nearest ¼ man-hour in each activity.

Cost Development

Four main cost categories were developed for use in analysis of the total cost of sap production:

1. *Equipment cost.*—The equipment costs for the various sizes of operations were developed by averaging up to three prices (1972) as quoted by various sugarbush equipment suppliers. Annual cost charges for equipment were determined by using a 10-year straight-line depreciation schedule for tubing-system equipment and a 30-year straight-line depreciation schedule for bucket equipment. In addition, a 7-percent interest on investment was charged to both collection systems.
2. *Labor cost.*—All labor input to the production of sap was charged a flat rate of $2.25 per hour. This included not only the operator and family labor input, but also any hired labor used during the sap season.
3. *Material cost.*—The materials used in sap production such as paint, wire, coding tags, etc. were charged at actual cost.
4. *Land overhead cost.*—This is generally not considered a cost of production by most sugar producers. However, taxes must be paid on the land, and there is an economic loss in timber value when a maple tree is tapped. To account for taxes and loss in timber value, a flat rate of 11¢ per tap (based on average local prevailing rates in

Figure 1.—Investment cost per tap for bucket and tubing-vacuum sap-collection systems.



Vermont) was charged to the production of sap. The flat-rate charge was used because of the wide variation in local tax rates and differing timber values per acre.

What We Found

Tubing system investment costs less.—All sizes (number of taps) of tubing operations required less investment for equipment than bucket operations (fig. 1). We found that equipment cost per tap for the average size tubing operation (2,400 taps) was $1.91 as compared to $2.54 for the average size bucket operation (2,200 taps).

The investment cost per tap is greatly influenced by the size of the operation or number of taps. The reason is simple: as you increase the number of taps, cost per tap for equipment such as power tappers, vacuum pumps, storage tanks, and hand tools becomes relatively lower as it is averaged over a larger base.

To illustrate: in our study, the smaller tubing operations (2,000 taps and less) had an average investment cost of $2.12 per tap, while the larger operations (2,000 to 4,000 taps) had an average cost of $1.88 per tap. In contrast, the smaller bucket operations (2,000 taps and less) had an average investment cost of $3.12, and the larger bucket operations (2,000 to 4,000 taps) had an average cost of $2.41 per tap.

Requires less labor.—Producers who used plastic tubing averaged 22 percent less labor input than producers who used buckets. This is important because hiring seasonal labor may be a problem. The total labor time per tap for tubing operations ranged from 7.8 to 12.0 minutes, an average of 9.6 minutes per tap. The labor for bucket operations ranged from 9.7 to 13.9 minutes per tap, an average of 12.3 minutes.

In terms of labor cost, at an hourly wage rate of $2.25 per man-hour, the installation of one tubing tap would cost 36¢ compared with 46¢ for one tap with buckets.

Further, the greatest percentage of labor time required with the bucket system is during sap-flow periods, whereas with a tubing system the greatest percentage of labor time is required in the set-up period before sap flow

Figure 2.—Distribution of sap-production work activities for tubing-vacuum and bucket systems.

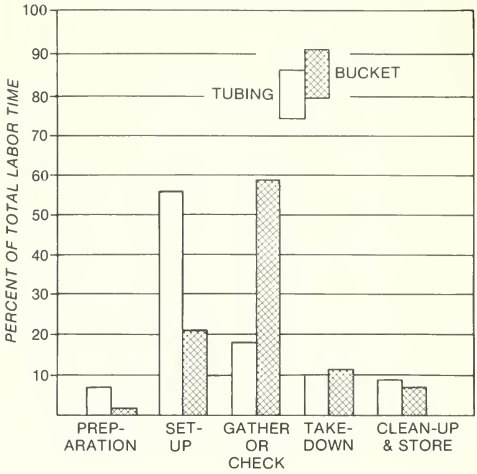


Table 1.—Average labor time[1] for each sap-production work activity

Activity	Tubing-vacuum	Buckets
	Minutes/tap	*Minutes/tap*
Preparation	0.6	0.2
Set-up	5.4	2.6
Gathering	.0	7.3
Checking tubing	1.7	.0
Take-down	1.0	1.3
Clean-up and storage	.9	.9
Total	9.6	12.3

[1] For operations of all sizes.

(fig. 2 and table 1). This indicates that labor for a tubing system is much less time-specific than labor for a bucket system, for which labor must be available when the buckets are ready to empty. Conversely, the set-up time for a tubing system can be spread over a longer time before the sap-flow periods. Thus, when sap-flow periods begin, tubing operators have already completed the major labor requirement and can concentrate on sugarhouse activities.

Long-run operating cost.—The sugar producer who has already invested in his equipment for collecting sap is concerned with his

annual operating cost. For the two systems studied, we found that tubing systems had the least annual operating cost. The total annual cost for tubing operations ranged from $1.05 per tap for a 607-tap operation down to 80¢ per tap for a 3,625-tap operation. For the computed average size of a tubing operation (2,393 taps), the total annual cost was 86¢ per tap (table 2).

In contrast, the total annual cost for bucket operations ranged from $1.03 per tap for a 610-tap operation down to 85¢ per tap for a 4,296-tap operation. For the computed average size of bucket operations (2,248 taps), the total annual cost was 93¢ per tap (table 3).

The principal reason why a tubing system has a total annual cost less than a bucket system is because labor costs less (36¢ versus 46¢). This is the area in sap production where better use of labor can have a substantial effect on the total cost of operation.

Minimum size of profitable operation.—For a range of size classes, there is a break-even point at which the income from sugarbushes just covers the costs of operation. For the sugarbushes that we studied, the total annual

Table 2.—Average total costs per tap for tubing-vacuum sap-collection systems

	Size	Annual[1] equipment cost	Labor cost	Material[2] cost	Rental cost	Total annual cost
	Number of taps	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
	607	0.50	0.36	0.08	0.11	1.05
	868	.39	.36	.06	.11	.92
	1,939	.31	.36	.04	.11	.82
	2,435	.31	.36	.04	.11	.82
	3,344	.30	.36	.04	.11	.81
	3,625	.30	.36	.03	.11	.80
	3,936	.33	.36	.03	.11	.83
Average	2,393	0.35	0.36	0.04	0.11	0.86
Percent of total	—	40.00	42.00	5.00	13.00	100.00

[1] Includes cost of snowmobile.
[2] Includes operating costs for gas, oil, and maintenance.

Table 3.—Average total costs per tap for bucket sap-collection systems

	Size	Annual[1] equipment cost	Labor cost	Material[2] cost	Rental cost	Total annual cost
	Number of taps	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
	610	0.35	0.46	0.11	0.11	1.03
	1,022	.34	.46	.08	.11	.98
	1,533	.33	.46	.07	.11	.97
	1,736	.33	.46	.07	.11	.97
	2,003	.26	.46	.07	.11	.90
	2,943	.25	.46	.06	.11	.88
	3,840	.25	.46	.06	.11	.88
	4,296	.23	.46	.05	.11	.85
Average	2,248	0.29	0.46	0.07	0.11	0.93
Percent of total	—	31.00	49.00	8.00	12.00	100.00

[1] Includes cost for tractor and sled.
[2] Includes operating costs for gas, oil, and maintenance.

cost decreased as number of taps increased—up to about 2,900 taps for tubing systems and 3,800 taps for bucket systems. Then the cost remained nearly constant.

We found that an operation of 1,300 taps was the break-even point for tubing systems and 2,200 taps for bucket systems. In both instances we assumed that each tap would yield 10 gallons of sap with a sugar concentration level of 2.5° Brix (Brix value approximates the percentage of sugar solids by weight in maple sap). Thus, operators with more taps should make a profit, and those with fewer taps may be operating at a loss.

The primary reason for the 900-tap spread between the break-even size for tubing systems versus bucket systems is due to savings in labor costs for the tubing systems. This will become the critical factor in sap production as seasonal labor becomes more difficult to find and labor costs increase.

Conclusions

We have examined and compared the costs of the two principal sap-collection systems being used today. Our results indicate the following:

1. The average initial investment cost for sap-collection equipment is less for a tubing system than for a bucket system ($1.91 per tap versus $2.54 per tap). This is an important consideration for producers who are planning to replace old equipment or for people who are considering going into the business.
2. A tubing system requires less labor time than a bucket system (9.6 minutes per tap versus 12.3 minutes per tap). Also, the greatest concentration of labor for a tubing system comes before sap begins to flow, thus enabling the producer to spend more time at the sugarhouse. For a bucket system, most of the labor is required during the sap-flow period.
3. The total annual operating cost for a tubing system is lower than the cost for a bucket system. This is due primarily to the lower labor cost for a tubing system.
4. Small tubing operations show more profit potential than small bucket operations. The break-even point for tubing systems was 1,300 taps as compared with 2,200 taps for bucket systems, assuming a yield of 10 gallons per tap of 2.5 Brix sap. This will change with sap yield and Brix value, and producers who do not consider interest and depreciation as a cost of production and those who do not charge for family help will have a different break-even point.
5. One other important factor is sap-volume yield per tap. For this study, we recorded annual sap yield for both systems and found that average sap-volume yields for tubing systems were 11.4 gallons of sap per tap as compared with 8.9 gallons for bucket systems—about a 28-percent increase in sap yield per tap for the tubing systems.

It is important that each sugarmaker keep accurate cost records so that areas of high cost can be pinpointed and steps can be taken to reduce these costs. The key for a successful maple operation is to increase the overall efficiency of the operation to keep costs of production under control and to maintain an acceptable margin of profit.

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